

TECHNICAL DESIGN NOTE

Project name	121 Princess Street		
Design note title	Supplementary Acoustic Mitigation Strategy		
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1. BACKGROUND

- 1.1 Hydrock is appointed by Centurion Investments (JS VII) Ltd trading within the UK as Dwell Student Living (DSL) to advise on acoustic matters regarding the scheme of sound insulation installed at 121 Princess Street, Manchester.
- 1.2 I am a Principal Acoustic Engineer and an Associate at Hydrock. I lead our acoustic engineering team in Manchester. I hold an MSc in Acoustics and Music Technology from The University of Edinburgh and hold full corporate membership to the Institute of Acoustics. I have worked as an acoustic engineering for 8 years following completion of my studies.
- 1.1 Prior approval for the change of use was granted by the Council on 22 November 2016 (ref: 114023/P3OPA/2016). The Planning Permission was granted subject to conditions. Condition 3, regarding acoustics, is worded as follows:

"3. Before the development commences a scheme for acoustically insulating the residential accommodation and any associated plant against traffic noise from Princess Street and the adjacent Railway Line and against noise from the existing basement nightclub and any other actual or potential sources of noise on or near the site including any approved ground floor uses shall be submitted to and approved in writing by the City Council as local planning authority. The approved noise insulation scheme shall be completed before any of the dwelling units are occupied. Prior to occupation a post completion report to verify that all of the recommended mitigation measures have been installed in the residential accommodation shall be submitted and agreed in writing by the City Council as local planning authority and any non-compliance suitably mitigated in accordance with an agreed scheme prior to occupation.

Reason - To secure a reduction in noise in order to protect future residents from noise nuisance, pursuant to policies SP1, H1 and DM1 of the Core Strategy."
- 1.2 Peak Acoustics ("PA") were appointed by Beech Holdings (Manchester) Ltd (the Developer) to address Condition 3. PA prepared an acoustic report (ref: TH1412162NR) outlining a scheme of acoustic mitigation to control noise incident at the proposed development, including that generated by the uses at basement and ground floor level. PA's report was informed by the results of acoustic surveys that had previously been undertaken by Philip Dunbavin Acoustics ("PDA") in 2015.
- 1.3 PA's scheme of acoustic mitigation was submitted to and approved by Manchester City Council ("MCC"), discharging the first part of Condition 3, on 20 April 2017.
- 1.4 PA were retained in their capacity as acoustic consultants during construction, and reviewed proposed construction detailing with the aim of ensuring that the acoustic efficacy of their proposed scheme of acoustic mitigation was not compromised.

- 1.5 Condition 3 requires the submission of a post-completion report to verify that the scheme of acoustic scheme of mitigation was installed in accordance with the approved scheme. PA prepared a Post-Installation Report (ref: TH2401181NR). This report outlines PA's on-site inspections of the works, and is supported by a number of pictures taken during the works. PA's conclusion within this report was "that all of the mitigation measures specified within the Noise Impact Assessment issued 6 April 2017 have been implemented and completed in accordance with the approved recommendations."
- 1.6 PA's Post-Completion Report was submitted to MCC on 16 February 2018 to discharge the remaining elements of Condition 3 (ref: 114023/P3OPA/2016). The Council refused this application on 31 October 2018 on the basis that post-completion noise measurements should have been undertaken to verify that the scheme of acoustic mitigation was effective.
- 1.7 PA subsequently undertook a scheme of noise measurements as outlined in their Internal Ambient Noise Measurements report (ref: LH2408181.2NR). The outcome of this report was that noise levels in the majority of spaces met MCC's requirements, with marginal failures in three spaces. This was submitted to MCC to support another application to discharge the remaining elements of Condition 3 on 9 November 2018, however this remained undetermined by MCC.
- 1.8 An application was then submitted to vary Condition 3 of the Planning Permission, with the revised condition seeking to secure retention of the Acoustic Scheme for as long as the Property remained occupied for residential purposes. By a decision notice dated 7th June 2019, MCC 'allowed' the Variation Application, however the wording of this condition was amended by MCC outlining a requirement to undertake pre-completion noise measurements (Condition 2 (a)). The proposed wording of Condition 2(a) is as follows:
 - 1.3 *"2) (a) Within 4 weeks of the date of this decision, a scheme for acoustically insulating the residential dwellings hereby permitted against any actual or potential sources of noise from any commercial/industrial premises in the vicinity of the development (including in particular entertainment noise from the lawful operation of the nightclub in the basement of the premises and the potential entertainment noise from the permitted use of the currently-vacant ground floor of the premises) shall be submitted to the local planning authority in writing for its written approval. The scheme shall:
 - (i) provide details of the acoustic insulation already installed in the development,
 - (ii) demonstrate whether and, if so, how the acoustic insulation installed in the development achieves the following noise criteria in respect of all apartments hereby permitted:*
 - *Bedrooms (night time - 23.00 - 07.00): 30 dB L_{Aeq} (individual noise events shall not exceed 45 dB $L_{Amax,F}$ by more than 15 times)*
 - *Living Rooms (daytime - 07.00 - 23.00) 35 dB L_{Aeq}*
 - *Gardens, balconies and terraces (daytime) 55 dB L_{Aeq}*

- *in respect of the entertainment noise from the basement and ground floor premises, noise levels in the 63Hz and 125Hz octave centre frequency bands do not exceed 47dB and 41dB, respectively in habitable rooms, measured at 5 minute intervals over both the daytime and night time periods set out above.*

(iii) where the existing acoustic insulation does not achieve all of the noise criteria stated above, the scheme must provide details of the further acoustic insulation to be provided or other measures to be taken and shall demonstrate that the further insulation or measures would achieve compliance with each of the noise criteria specified above. The scheme must also specify a timetable for the carrying out of such further measures;

(iv) Where additional works or measures are required, the scheme shall include for the local planning authority's approval details of the sound testing and other steps which will be taken to ascertain whether the works or measures have achieved compliance with the criteria set out in part (a) of this condition and which will form part of the verification report referred to below.

Where further acoustic insulation or other measures are required and set out in the scheme, that further insulation shall be installed and/or those measures shall be taken within the timescale approved by the local planning authority.

(b) Within 4 weeks of the completion of the further insulation works or other measures detailed in the approved scheme for acoustic insulation, a further report (the "verification report") shall be submitted to the local planning authority for approval. The verification report must accord with the details approved by the local planning authority and must demonstrate:

(i) That the further acoustic insulation or other measures have been installed or taken, that they have been tested and whether they achieve the internal noise criteria set out above, and

(ii) If the verification report does not demonstrate that the noise criteria specified above can be met, the report shall include details of the further works or measures to be taken ("the remedial works") to achieve compliance with the noise criteria specified above, together with a timetable for their carrying out. The remedial works shall be carried out in accordance with the approved timetable and the requirements of part (b) of this condition shall apply to the remedial works and any subsequent requirement for further remedial works.

(c) The acoustic insulation and any other measures forming part of the approved scheme or schemes and any verification report shall be retained in situ for as long as the use hereby permitted continues.

(d) If any obligations under this condition are not complied with, then the occupation of any apartment hereby permitted shall cease within 4 weeks of the local planning authority confirming in writing that such a failure has occurred and no apartment shall be re-occupied until the local planning authority has confirmed in writing that any failure to comply with this condition has been remedied.

Reason: To secure a reduction in noise from commercial and entertainment sources in order to protect residents from noise disturbance pursuant to Core Strategy Policies DM1 and SP1 and saved UPD Policy DC26".

- 1.9 An appeal was lodged against the imposition of the varied noise condition. This appeal was to be determined by a Planning Inspector following a hearing on 21st January 2020, however this hearing was adjourned, and the parties are currently waiting to hear from the Planning Inspectorate with a date for a new hearing (or an inquiry).
- 1.10 Fifth Leisure ("FL"), who operate the nightclub at basement level and are the leaseholder of the ground floor (which is licensed to operate as a bar) are actively participating in the appeal process and have appointed Miller Goodall ("MG") to act as acoustic consultants. MG have submitted a proof of evidence on behalf of FL critiquing PA's design, noise measurements and challenging the contents of a draft statutory declaration of Stuart Gough (Construction Manager who supervised conversion of the offices into residential apartments).
- 1.11 Following the adjournment of the hearing, it was mutually agreed between the Developer and FL to appoint an independent building surveyor to investigate the installation of the scheme of acoustic mitigation and to prepare a report which would be submitted to the Inspector in order to resolve the dispute. It was also suggested that a joint programme of noise measurements be undertaken.
- 1.12 The building survey identified a number of discrepancies between the approved scheme and the acoustic scheme which has been installed, though the surveyor was not qualified to comment on the acoustic implications of these deviations.
- 1.13 The Developer appointed Sound Consulting Limited (SCL) to undertake a programme of noise measurements. This was undertaken with cooperation from FL, and was overseen by MG and a representative from MCC. The agreed methodology is outline in SCL's Survey Methodology note (ref: SCL.P.20200.200317.TM3), and the results of the measurements are outlined in SCL's Music Noise Survey Results note (ref: SCL.P.20200.200911.R1).
- 1.14 The results of the noise measurements undertaken by SCL *"consistently show that the criteria are exceed for all noise sources with very few exceptions."*
- 1.15 Further analysis has revealed that the approved scheme was technically flawed in its design and therefore unlikely to be fully effective in mitigating noise transfer from FL's demise around the building. Some of the discrepancies between the approved scheme and installed scheme were also found, upon review by Hydrock, to have the potential to further reduce the ability of the mitigation to be fully effective.
- 1.16 Hydrock is working with DSL to develop a supplementary scheme of acoustic mitigation to augment the ineffective scheme of insulation which has been installed. This Technical Note has been prepared for the attention of MCC in order to address parts iii and iv of Condition 2(a).

2. POLICY CONTEXT AND RELEVANT GUIDANCE

National Planning Policy Framework (NPPF)

- 2.1 Published in July 2021, this document sets out the Government's planning policies for England and supersedes the previous version of the NPPF published in 2019. It makes the following reference to noise in the section entitled Conserving and enhancing the natural environment:

*"174. Planning policies and decisions should contribute to and enhance the natural and local environment by:
[...]*

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."

- 2.2 It also makes the following references to noise in the Section entitled Ground conditions and pollution:

"185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life⁶⁰;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

60 See Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food & Rural Affairs, 2010)."

- 2.3 And

"187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Noise Policy Statement for England (NPSE)

- 2.4 Published in March 2010, the Noise Policy Statement for England (NPSE) sets out the long-term vision of Government noise policy as follows:

"Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development."

- 2.5 The NPSE identifies three observed effect levels, names “No Observed Effect Level” (NOEL), “Lowest Observed Adverse Effect Level” (LOAEL) and “Significant Observed Adverse Effect Level” (SOAEL).
- 2.6 The NPSE contains little detail on assessment methodologies and specific parameters at which the varying observed effect levels would occur in the context of a residential development.

3. ACOUSTIC REMEDIATION STRATEGY

Summary of the installed scheme

- 3.1 As outlined above, an acoustician (PA) was appointed by the Developer to undertake an assessment of noise issues at 121 Princess Street and to provide acoustic design guidance during construction. The installed scheme, as recommended by PA, is summarised as follows:
- Installation of a concrete double-floor system to between ground and first floor level;
 - Installation of floor/ceiling sound insulation from second to sixth floor levels;
 - Installation of secondary glazing;
 - Installation of a mechanical ventilation (MVHR) system;
 - Installation of a sound resisting plasterboard linings to the outer building envelope;
 - Installation of inner lightwell insulation; and
 - Installation of column insulation.

- 3.2 In summary, the approved and therefore installed scheme has underestimated the significant contribution of structureborne noise transfer of music noise from FL's demise around the building.

Baseline situation

- 3.3 As outlined above, a scheme of joint noise testing was undertaken between the Developer and FL. The results of this testing are outlined in SCL's Music Noise Survey Results note (ref: SCL.P.20200.200911.R1).
- 3.4 For the purposes of this note, the baseline situation is to be based on the results of the joint testing. However, Hydrock have more recently visited the site to undertake a series of short supplementary measurements (with FL's cooperation). FL are in the process of refurbishing the basement and have installed substantial plasterboard linings to the majority of the demise. When Hydrock visited the site, this appeared to have reduced music noise levels in the accommodation. For robustness only the results of the joint testing will be considered.
- 3.5 SCL's testing considered a number of situations with regards to source noise. The most pertinent and comprehensive set of testing was undertaken with the nightclub operating 'as normal' with the sound systems in the main club area and bunker calibrated to typical levels as agreed with FL.
- 3.6 However, it is important to note that testing was also undertaken with a sound source in the ground floor unit. Whilst this did increase resultant noise levels within the accommodation, the bar unit is not currently operational and would be need to be fitted out appropriately. Further, it was noted at the time of SCL's testing that the façade was *"in a state of disrepair."* It is reasonable to expect that the fitout would include substantial linings of external walls to mitigate against noise breakout to external noise sensitive receptors. This in turn would reduce the level of noise exciting the structure at ground floor level and being transmitted upwards through the building. It therefore follows that SCL's measurements of noise transmission from uses within the ground floor unit are not indicative of a realistic situation and no meaningful assessment can be undertaken of such a use within the ground floor unit until details of the potential fitout are known. However the proposed supplementary mitigation will act to disrupt both the airborne and structureborne noise paths from the ground floor unit to upper floors.
- 3.7 The results of SCL's noise testing under 'normal conditions' (i.e. main area and bunker sound systems) within the basement are summarised as follows:

Area	Range of measured sound levels (dB, $L_{eq,T}$) at octave-band centre frequency (Hz)	
	63	125
First floor	58 – 68	50 – 66
Third floor	47 – 62	42 – 55
Sixth floor	47 - 62	36 - 52

3.8 Based on Condition 2(a) and MCC's supplementary planning guidance is as follows:

"in respect of the entertainment noise from the basement and ground floor premises, noise levels in the 63Hz and 125Hz octave centre frequency bands do not exceed 47dB and 41dB, respectively in habitable rooms, measured at 5 minute intervals over both the daytime and night time periods set out above."

3.9 The level of exceedance above MCC's requirements are summarised in the following table:

Area	Level of exceedance (dB, $L_{eq,T}$) at octave-band centre frequency (Hz)	
	63	125
First floor	11 – 21	9 – 25
Third floor	0 – 15	1 – 14
Sixth floor	0 – 15	0 – 11

- 3.10 SCL did not undertake any testing on the second, fourth or fifth floors. However, several sets of testing have been undertaken by various parties (MG, PA and Hydrock), the results of which indicate that conditions are relatively similar on all floors with the exception of the first floor.

Description of supplementary scheme of mitigation

- 3.11 Given that the source of noise is within the basement, it is clear that noise is not travelling via direct i.e. airborne noise transfer paths. The cause of the issue is that noise from music within FL's demise is sufficiently powerful to excite (i.e. cause to vibrate) the building's structure. The vibration is transmitted through the structure, where it excites the air, much like a loudspeaker, becoming audible in the residential floors above.
- 3.12 The solution to this issue is to break or disrupt the vibration transmission path. This is achieved by physically separating the structure (external walls and columns) on the accommodation side of the building on the first floor at low level, from the ground floor and basement. Where the separation has been made, a layer of specifically designed isolators is installed which support the building. The first floor would remain rigidly connected to the structure at the ground floor and basement. It is therefore also proposed to install a new concrete floor mounted on acoustic isolators within the first floor to ensure the finished floor is also acoustically isolated to the same level.
- 3.13 The first floor is to be completely stripped out and refitted. Measurements will be undertaken once the isolators and new acoustic concrete floor have been installed to determine the level of remaining noise being radiated within the first floor. The outcome of this interim testing will inform the fitout of the space. This will include appropriately specified linings to external walls and other structural elements (likely multiple layers of dense plasterboard).
- 3.14 A relevant case study has been provided by Mason UK, who will provide the acoustic isolators, for a similar installation. These are appended to this technical note.

Assessment of supplementary scheme of mitigation

- 3.15 Mason UK have shared test data from a similar installation elsewhere to provide an anecdotal basis for assessment. This data is presented in the table below.

Range of vibration transition loss (dB) at octave-band centre frequency (Hz) achieved with similar installations*	
63	125
10 - 15	15 - 20

- 3.16 The improvements in transmission loss outlined above relate to a loss of vibrational energy within the structure. Whilst there is no reliable means of calculation, re-radiated noise is directly proportional to transmitted vibration. It is therefore reasonable to expect that the losses would translate to equivalent reductions in noise levels within rooms.
- 3.17 With reference to the previous table outlining the levels of exceedance, it is anticipated that the proposed solution should, in the majority of cases (excluding the first floor), bring music noise levels within MCC's criteria at 63Hz (47 dB) and 125Hz (41 dB). However, as discussed, given the nature of the proposed supplementary mitigation, it is not possible to accurately predict the resultant noise levels in bedrooms. There is potential for occasional minor exceedances of MCC's criteria depending on the type and/or level of noise within FL's demise.
- 3.18 Minor exceedances are anticipated within the first floor with the proposed solution. However, the first floor is to be stripped out in its entirety in order to install the isolators and new acoustically isolated concrete floor. A series of interim testing measurements will be undertaken with the first floor to quantify the level of noise being re-radiated by the structure. Provision will then be made in refitting the first floor for uprated plasterboard linings to structural elements.
- 3.19 It is considered that the proposed supplementary noise mitigation scheme represents the best practical remediation strategy in terms of reducing noise levels and the **only** feasible option given the situation. However, exceedances above MCC's requirements could occasionally give rise to adverse impacts in some rooms. PPG-Noise recommends that noise impacts within this bracket should be mitigated and reduced to a minimum.
- 3.20 It is therefore proposed that allowance is made during the final testing for exceedances up to +5 dB above MCC's criteria. If exceedances are found beyond this level, further investigation will be undertaken to determine whether there are any installation issues with the isolation to ensure that the scheme is mitigating the potential for adverse impacts as far as possible. This is considered to be a reasonable allowance given the historic nature of the building, noting that allowances are commonly made for relaxed acoustic criteria in refurbishment schemes owing to inherent limitations of older buildings.

4. SUMMARY

- 4.1 Details have been outlined regarding the supplementary acoustic scheme that is to be installed at 121 Princess Street. An indicative assessment has been undertaken to determine the effectiveness of the proposed scheme based on the results of tests undertaken on a similar installation. Whilst it is anticipated that the proposed scheme will reduce noise levels such that MCC's criteria are met in the majority of cases, it is anticipated that there may be rooms where these limits are occasionally exceeded, depending on the level and type of noise within FL's demise. The proposed scheme represents the best and only option to mitigate the risk of adverse impact. It is therefore proposed that allowance be made for during testing for minor exceedances of up to +5 dB.

Project Post Template

55-93 Knightsbridge, London

Mason UK designed and supplied the building isolation bearings for this large and prestigious development, which included an isolated retained façade.



Figure 1 – Render of the completed building, courtesy of Dixon Jones architects

This project was one of the most complex building isolation projects on which Mason UK have worked. The project involved the demolition of the existing early Edwardian structure, but leaving the listed façade behind. A new isolated structure was constructed, supported on 8Hz Mason bearings and resiliently connected back to the façade to provide structural support.



Figure 2 – The cleared site behind the façade

The building was not originally designed to be isolated, but the proximity of the Piccadilly line and the Knightsbridge road would have generated sufficient vibrational energy to cause undesirable noise levels within the building. The requirement was to isolate the new structure and connect back to the retained façade with bearings of maximum 8.0Hz natural frequency. The project was challenging in that the isolation line had to be accommodate with minimal disruption to the existing design.

The loading was complex. Walking columns meant permanently applied lateral loading in addition to the typical wind conditions. The isolation line was involved, largely sitting under the first floor slab but also running down to include the building cores (see figure 3 below), shear walls, façade and various stepped walls.



Figure 3 – Mason bearings being placed in one of the core pits. The green labels certifying passing of independent 150% load tests can clearly be seen. We do this for every bearing we make to ensure no risk of failure on site.

The value of the property meant that millimetres mattered. We went through enormous efforts to reduce the envelope required for bearing assemblies. Figure 4 shows a typical installation, the column capitals included the bearings supporting the structure above, lateral restraints and tension anchors to meet disproportional collapse requirements, downstops which would come into play during an extreme fire, fire protection and first fit architectural finishes. There were approximately 60 columns and each one was engineered differently to save space.

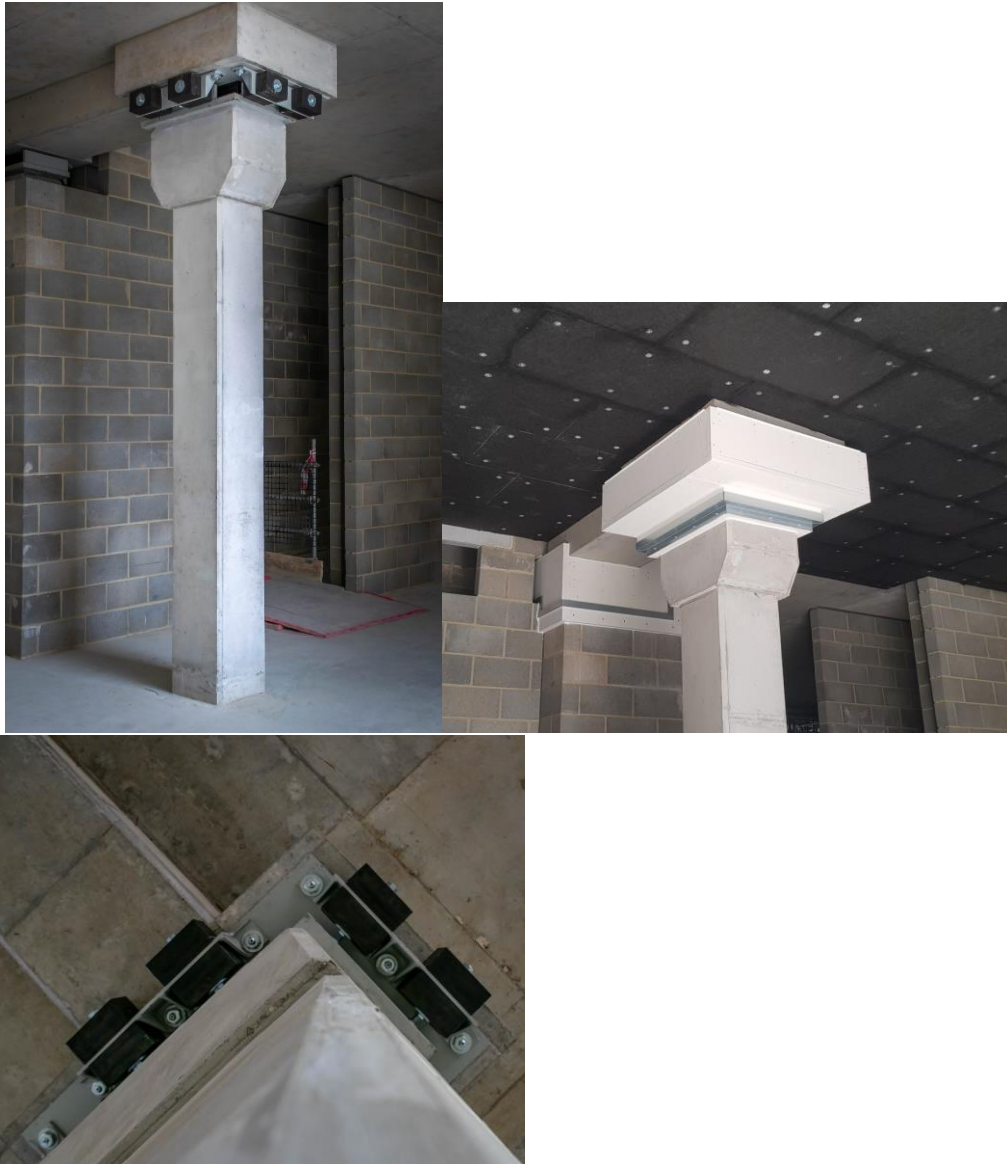


Figure 4 – Isolating bearing assemblies. <<can these be put into a single image with the boxed in one last>>

Multiple walls interfaces were also isolated, where noisy met quiet structure. We engineered the bearings and special telescoping lateral restraints which fitted within the wall width, please see figure 5.



Figure 5 – Isolation bearings and bespoke lateral restraint system



Figure 6: Close up of bearing and lateral restraints

The final challenge was providing robust but isolating restraints for the listed façade. We had to produce a very specific spring rate as a compromise between the acoustic and structural concerns, plus we carried out static and dynamic testing to demonstrate we met the criteria. Isolating laterally is challenging as without gravity loading the use of pre-compressed isolators is necessary, but these must not compromise the global building modes.

Approximately 300 of our special ties were used as the sole support for this fragile structure, please see figure 7.



Figure 7: Mason façade ties being installed

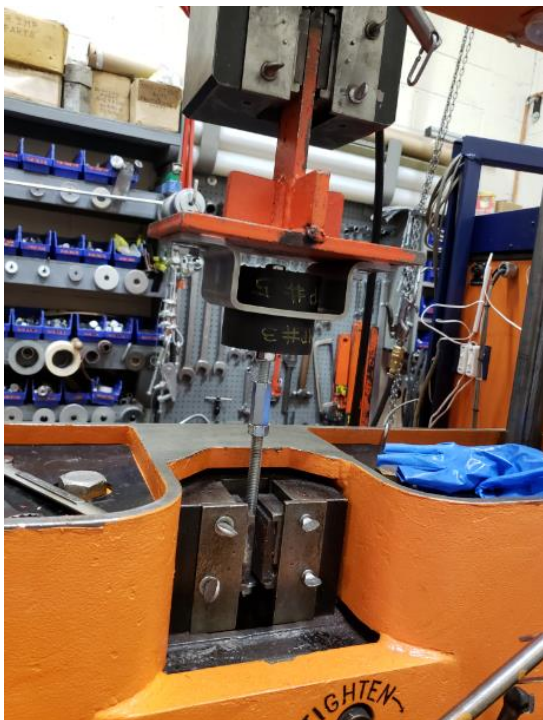


Figure 8: Facade tie testing programme

The project cumulated in successful acoustic testing, even when carried out at shell and core stage. We design our bearings to meet the criteria under 80% loading to provide a tolerance, this successful approach meant savings could be realised on further treatment within the building. We were pleased to be part of the design team throughout the project and carried out full QA checks and support to the contracting team during construction.

This project is an example of how we can solve many challenges through good design and coordination. We would be pleased to discuss in more detail or if we can help with any other building isolation project.

Excerpt: *Mason UK designed and supplied the building isolation bearings for this large and prestigious development, which included an isolated retained façade. The project involved the demolition of the existing early Edwardian structure, but leaving the listed façade behind. A new isolated structure was constructed, supported on 8Hz Mason bearings and resiliently connected back to the façade.*